DOCUMENT RESUME

ED 212 197 HE 014 651

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TITLE A Discriminant Analysis of the Relationship between Selected Intellective and Nonintellective Variables and the Completion of College Majors at Western State College of Colorado in the General Fields of Business and Nonbusiness.
PUB DATE [81]
NOTE 20p.

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Academic Aptitude; Academic Aspiration; *Academic Persistence; *Business Administration Education; Decision Making; Higher Education; Institutional Research; *Majors (Students); Predictive Measurement; *Predictor Variables; *Sex Differences; State Colleges; Student Characteristics; Student Interests
IDENTIFIERS *Western State College of Colorado

ABSTRACT

The use of certain variables in predicting the probability of persistence to graduation for students majoring in business or nonbusiness was examined at Western State College of Colorado. The study sample consisted of 131 students from the 1977-78 graduating class, of whom 52 were nonbusiness majors and 79 were business majors. Predictions of major field of study also were run separately for the 46 men and the 33 women in business. The 16 predictor variables, taken from the American College Testing Program Assessment student profile reports, included aptitude scores, choice of major, and interest inventory scores. It was found that differences between groups were not entirely accounted for by discriminant function equations and the study variables. It appears that there is an extraneous variable that causes or encourages men to major in business while preventing (borderline) women from majoring in business. Of the six nonbusiness students who were predicted as most closely resembling the business groups, but who completed nonbusiness majors, all were women. Of the 14 business students who were predicted as most closely resembling the nonbusiness group, but who completed business majors, 12 were men. The findings generally indicate that intellective and nonintellective sets of measures are useful in predicting majors at the time of graduation. Prediction is better for men and women in nonbusiness than it is for those in business. There is a need to know more about characteristics of persons who attend college and about the impacts different kinds of college environments have on different categories of students. (SW)

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A DISCRIMINANT ANALYSIS OF THE RELATIONSHIP BETWEEN SELECTED INTELLECTIVE AND NONINTELLECTIVE VARIABLES AND THE COMPLETION OF COLLEGE MAJORS AT WESTERN STATE COLLEGE OF COLORADO IN THE GENERAL FIELDS OF BUSINESS AND NONBUSINESS

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PREDICTING SUCCESS IN AN UNDERGRADUATE BUSINESS ADMINISTRATION PROGRAM UTILIZING INTELLECTIVE AND NON-INTELLECTIVE DATA: MODEL DEVELOPMENT, AND CROSS VALIDATION

Understanding the complexities of educational choice and completion of a particular college major has been a problem faced by counselors and admission officers for some time. Although the decision of how such a choice is made is not completely understood, many researchers assume that student choices involve a process of matching certain intellective and nonintellective characteristics with the demands and rigors of a particular field of study. For example, John Holland (1973) writes, "The more closely a person resembles a particular type, the more likely he is to exhibit the personal traits and behaviors associated with that type." Holland argues that people can often be classified by the types they most closely resemble, also that various kinds of environments exist in which people work, play, study, and in brief, live. Certain kinds of individuals are more or less compatible or comfortable with that type of environment which most closely resembles their own personal makeup, as defined by the individual's unique intellective and nonintellective characteristics. Holland assumes that "people search for environments that will let them exercise their requisite skills and abilities, express their attitudes and values, and take on agreeable problems and roles."

If such is the case then it would seem that if a student's intellective and nonintellective traits are similar to the traits of other students in a given field of study, he or she will be more satisfied and remain in that field. Conversely, if a student's traits are dissimilar from those of other students in the same field of study, he or she will be dissatisfied and will change to another field of study. And, it may be assumed that the student

will continue to change fields of study until finding a field where he or she feels most comfortable. Thus, they change fields of study until they find a field of study where they are most like the other students majoring in this field.

The primary purpose of this research was to examine the use of certain intellective and nonintellective variables in predicting the probability of a given student graduating in one of two general fields of study. The specific study undertaken examined the relationship between these two categories of data and the persistence of students who had completed majors in business or nonbusiness.

For purposes of the investigation the major problem under examination was divided into three subproblems: (1) Do distinctive or different types of students complete different majors?, (2) To what extent, if any, do the intellective and nonintellective measures enable one to predict persistence in business or nonbusiness?, and (3) Of the men and women who complete business majors, are the women as predictable as the men in terms of their persistence. Thus, consistent with Holland's theory, it was hypothesized that two sets of measures can be used to predict successful completion, i.e., persistence.

METHOD

Sample

The sample of 131 students included in the study were members of the 1977-78 graduating classes. This primary sample consisted of 52 men and women in the nonbusiness group and 79 men and women in the business group. With this resulting sample of 131 student persistors and employing the technique of discriminant analysis, the levels of predictiveness of the two groups were

established. Additionally, in order to gain further insight, the predictions of major field of study were run separately for the 46 men in business and the 33 women in business. Thus, the two major groups and the two sub-groups whose entrance data were investigated as to their effectiveness as predictors of major field of study at graduation included all students in business, all students in nonbusiness, men in business, and women in business.

Independent Variables or Predictors

The entrance data used in the study consisted of sixteen variables taken from the American College Testing (ACT) Program Assessment Student Profile Reports. The measures of individual student variables were measures of each student's intellective ability and nonintellective characteristics. ACT measures were utilized because they have frequently been identified in studies directly related to counseling and admissions procedures (Abe & Holland, 1965), (Goldschmid, Marce L., 1967), (Lutz & Richards, 1967), (Holland & Lutz, 1968), (Nicholson, 1973), (Lenning, 1975), and (Aleamoni & Oboler, 1977).

The variables examined in this study consisted of the following: English aptitude scores, mathematical scores, proposed (planned) educational major (also called major academic field of study), certainty of planned educational major, first vocational choice, certainty of first vocational choice, extent of participation in high school extracurricular activities, age of students expressed in number of years since birth rounded to nearest month, and six standard ACT interest inventory scores which measure a student's interest in science, creative arts, social service, business contact, business detail, and technical. These six ACT interest inventory scores measure the extent of a student's work and study-related-interests based on his or her familiarity of the six categories.

Dependent Variables or Criterion

Successful completion of, i.e., persistence in, either business or non business was achieved by all students in the sample. Students were categorized

or placed into one of two groups during the primary analysis, and were placed into one of two sub-groups during the secondary analysis. Thus, membership in one of two groups, and then one of two sub-groups was predicted using discriminant analysis.

Discriminant Analyses

Since the study involved a categorical dependent variable and sixteen measureable variables, discriminant analysis was employed as the statistical technique for analyzing the data and classifying students for each of the two major groups and then employed again for the two sub-groups of students, i.e., men in business and women in business.

The use of discriminant analysis (Tatsuoka, 1954), Overall & Klett, 1972), (Kerlinger, 1979), and (Hair, 1979) is an appropriate technique where the purpose is to classify people in that group they most resemble. This application is consistent with that used by (Fishman, 1957), (Dunn, 1959), (Stahmann and Walker, 1969), (Stahmann, 1969) and (Kerlinger and Pedhazue, 1973). Additionally, discriminant analysis is appropriate to use for describing and contrasting members of separate groups (Fisher, 1933), (Christensen, 1953), and (Cattell, 1966) and, for comparing groups using common dimensions, i.e., common traits, characteristics or measures. Thus, the study was both a descriptive analysis and a predictive study.

One discriminant function was obtained for the primary groups and one was obtained for the sub-groups. Each of these discriminant function equations was calculated using an experimental sample of students consisting of approximately one-half the members of that respective group. The other half of the group members were considered a holdout or cross-valication sample and were used to make predictions. Both samples from each group contained students who were randomly assigned with the aid of a table of random numbers.

Discriminant analysis enables one to derive different discriminant functions, using, for example, each of several criterion groups. These functions can then be employed to predict, through a classification process of like-types, the majors at time of graduation of members of a cross-validation sample. Comparing the results of preduction with actual majors completed by students and keeping in mind the probability of chance happenings gives additional insight into the usefulness of the discriminant function equations for predictive purposes.

Consistent with Hair's approach (Hair, 1979) the application of the discriminant analyses were each divided into three major steps: (1) derivation, (2) validation, and (3) interpretation.

RESULTS

Discriminant analysis enabled this researcher to separate groups on the basis of a common set of measures, to classify or predict group membership on the basis of these differences, and to describe the extent of the differences based on the measures employed in the investigation.

Linear discriminant function equations were obtained for the business and nonbusiness grouping and for the men in business and women in business sub-grouping. The discriminant scores for the primary groups and the sub-groups appear in Table 1.

Statistical significances of the differences between groups was established using the Mahalanobis D^2 statistic. The generalized D^2 values also appear in Table 1. Since the D^2 values were significant, the groups were then deemed to be significantly different based on the variables being used to separate the groups. This approach is consistent with that of Cole (1964). While D^2 does not exhaust all the differences between groups, it does deal with the differences based on the variables used. And, these variables

Table I

Mahalanobis D^2 and Discriminant Function Equations: Experimental Samples*

Variables	Men-&-Women-in-Business	Men-&-Women-in-Non-business	Men-in-Business	Women-in-Business
X_1	.61626	.99413	.48556	.81138
X_2	.95441	.86603	.94733	.88938
X_3	-.37488	-.46466	-1.29285	-1.34632
X_4	1.29464	1.29086	1.66463	1.53910
X_5	2.15521	2.73661	-3.51082	-3.67081
X_6	-12.99660	-12.27793	-18.36797	-18.24750
X_7	-.71966	.89991	7.04191	4.98144
X_8	11.66974	9.43151	7.30967	7.45211
X_9	-.30378	-.02207	-1.51926	-1.41959
X_{10}	8.49834	8.11844	9.04373	8.72359
X_{11}	-.29880	-.60030	-.58651	-.55663
X_{12}	.38419	.43342	.72312	.70791
X_{13}	.86901	1.21989	.86093	.72838
X_{14}	.20790	.14960	.29184	.30508
X_{15}	.88952	.64370	1.26851	1.32584
X_{16}	.03681	.11891	-.13135	-.11642
D^2	137.68		35.42	

*The discriminant scores are obtained from multiplying the discriminant weights above with the individual student's sixteen measures and summing the results. The discriminant weights for the men-and-women-in-business and the men-and-women-in-non-business represent the results of one discriminant analysis performed on this pairing. The discriminant weights for the men-in-business and the women-in-business were obtained from a second analysis by pairing the groups against one another.

become the common denominator used in comparing and contrasting different groups, i.e., used to describe and study group differences.

The second stage in applying discriminant analysis; that is, the second step in developing a classification table to demonstrate the predictiveness or ability to assign individuals from a cross validation sample to one of two groups using the equation calculated, resulted in a range of success ratios from a low of 73.9% for the men in business to a high of 88.5% for men and women in nonbusiness. The results of the classifications, i.e., predictions, appear in Table 2.

The last stage of a discriminant analysis is to determine a rank serial ordering of the variables employed to separate the groups. This can be done using the adjusted discriminant weights taken from the linear discriminant equation. However, these standardized weights, according to (Rau, 1951), (Cooley, 1971), (Mulaik, 1972), (Lunneborg & Lunneborg, 1975), and (Hair, 1979) are not as reliable as are discriminant loadings. Discriminant loadings were used to develop the similarity profiles of the two main groups and the two subgroups. These profiles appear in Tables 3 and 4.

DISCUSSION AND RECOMMENDATIONS

Classification accuracies are very important outcomes of a discriminant analysis. The classification accuracies obtained in the present investigation suggest that the differences between groups are not entirely accounted for based on the discriminant function equations and the variables used in this study. For example, the predictiveness of women-in-business exceeding that of men-in-business suggests that there is something else, i.e., an extraneous variable, operating that causes or encourages men to major in business while preventing (borderline) women from majoring in business. Of the six non-business students who were predicted as most closely resembling the business group, but who completed nonbusiness majors, all were women. Of the fourteen

Table 2

Classification Accuracies for the Combined Samples of the Experimental and Cross-Validation Samples[a]

	Total N	"Hits" (ratio)	"Misses" (ratio)	Chance Event $C=p^2 + (1-p)^2$	D^2
Men-and-Women-in-Business	79	65 (82.3%)	14 (17.7%)	52%	111.14
Men-and-Women-in-Nonbusiness	52	46 (88.5%)	6 (11.5%)	52%	111.14
Men-in-Business	46	34 (73.9%)	12 (26.1%)	51%	44.79
Women-in-Business	33	26 (78.8%)	7 (21.2%)	51%	44.79

[a]"Hit" ratios which exceed 65 percent are significant.

Table 3

Similarity Profiles Based on the Discriminant Loadings for the Men-and-Women-in-Business and the Men-and-Women-in-Non-business: Cross-validation Samples

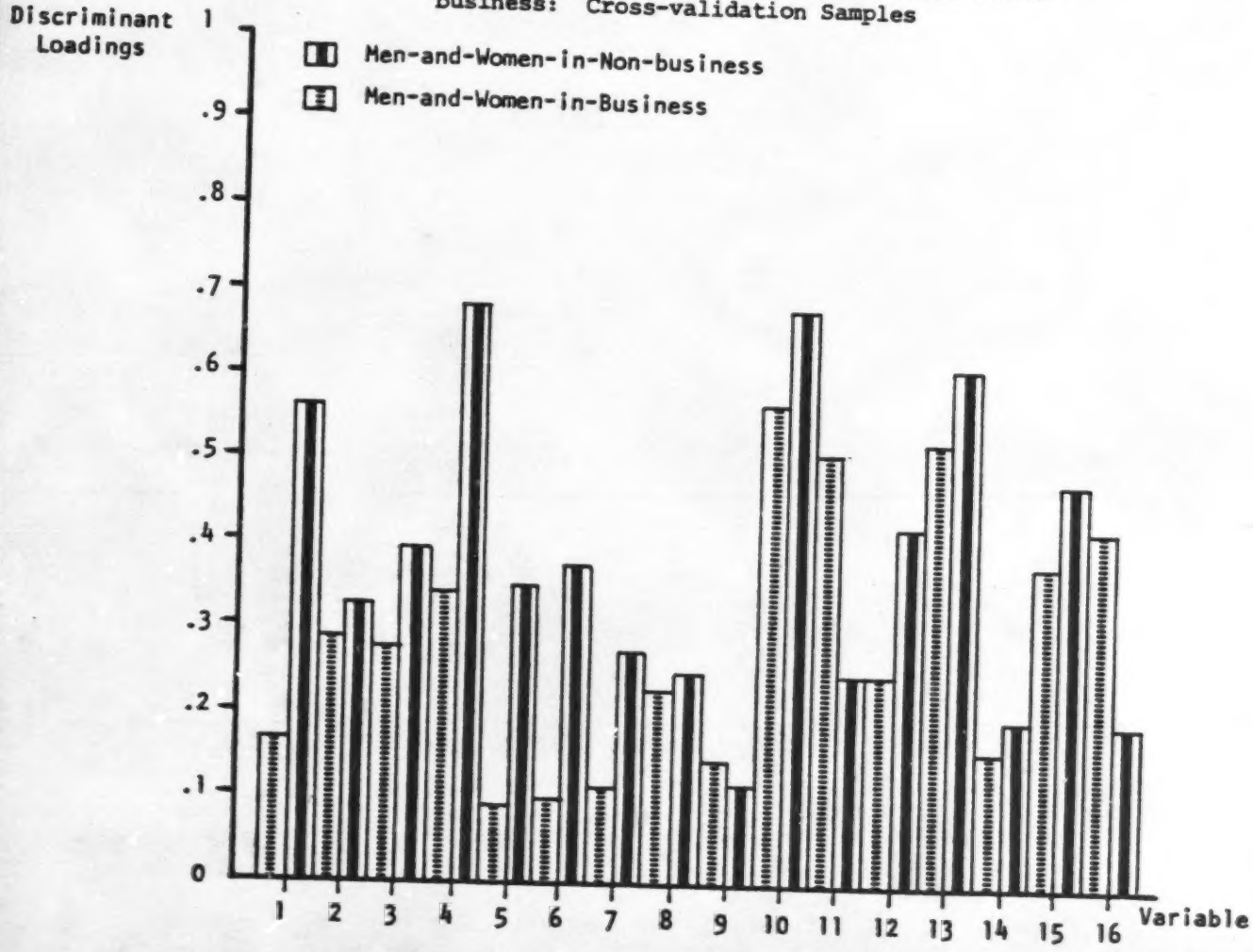
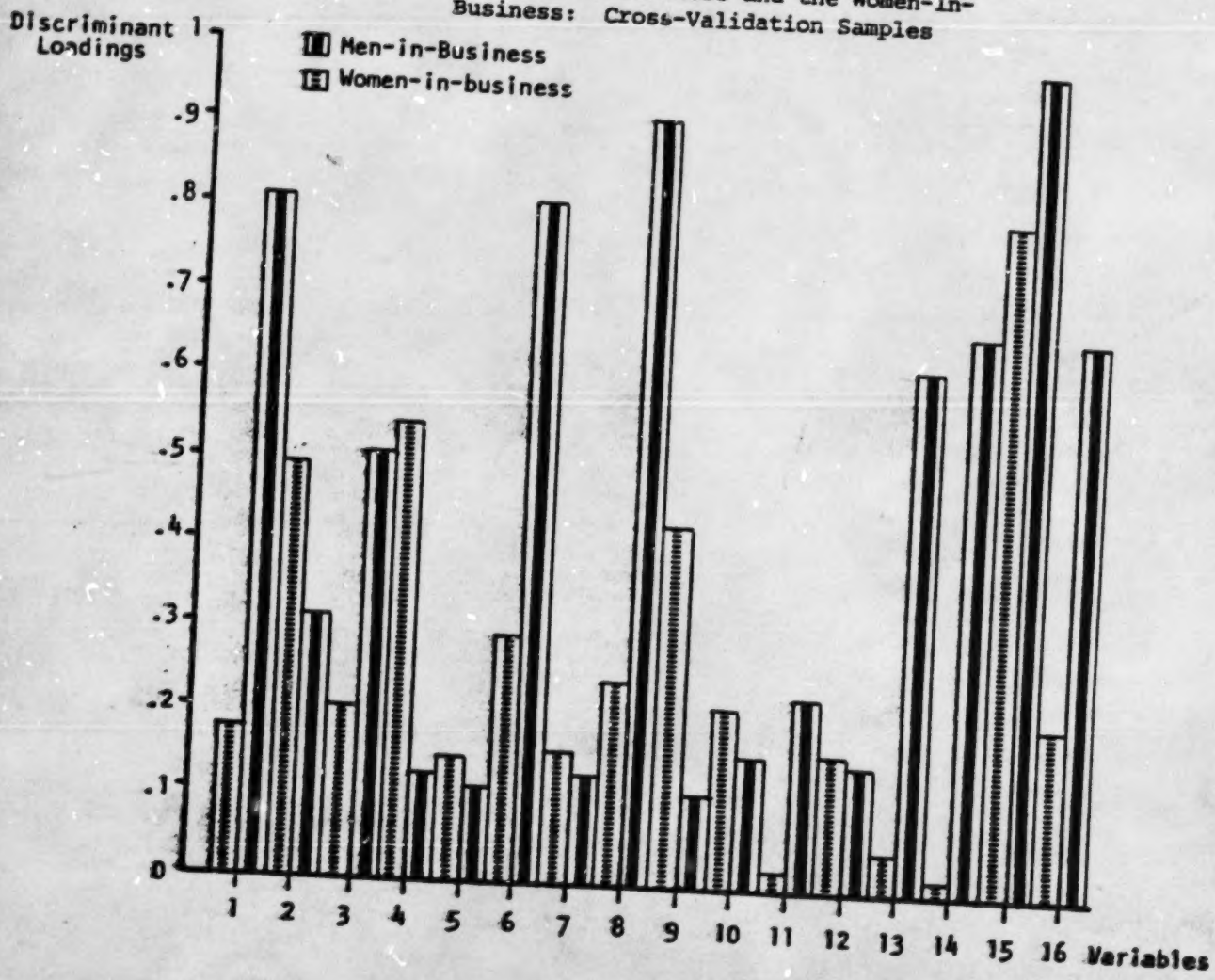


Table 4

Similarity Profiles Based on the Discriminant Loadings for the Men-in-Business and the Women-in-Business: Cross-Validation Samples



business students who were predicted as most closely resembling the non-business group, but who completed business majors, twelve were men. This seems to indicate that something is operating which forces some men into business majors while keeping some women out of business. The women who do go into business clearly resemble the business group, but this is not as readily apparent with the men who go into business. Women also appear to be better students, are more predictable, but enroll in business as a field of study less frequently than do their male counterparts. This researcher believes that something other than the sixteen variables is operating which keeps borderline women out of business as a field of study, while operating to keep borderline men in business.

Perhaps men feel they have to train for a lifetime of work, while women do not feel this way. Or, perhaps women feel hesitant about breaking into what has long been a traditionally male bastion. These issues were not investigated, but rather are offered as possible explanations of why borderline men select business while borderline women do not (when both have high and low discriminant scores which are nearly equal). There appears to be some sort of invisible hand, for example, societal pressures from family and peers, working to keep the borderline men in business while keeping the borderline women out of business majors.

Classification accuracies might be improved by increasing the sample sizes, by employing different variables which measure the reasons non-business students attend college, or by using more specific classifications instead of simply using business versus non-business. Additionally, the college environment might prove useful in a predictive study because of the various impacts the college experience has on different types of students. Assuming that the college environment does change a student during his or her four year involvement with higher

education, then researchers must find a way to predict the kinds of changes that take place within certain types of students if more accurate predictions of majors at the time of graduation are to be made using entrance data. Perhaps sets of measures should be taken throughout a student's college years to aid in assessing the educational levels and needs of students and to update the kinds of data counselors need in order to advise students about majors and career fields.

We need to know more about who goes to college for any of a number of different reasons. We also need to know more about the impacts that various kinds of college environments have on the types of students who attend. Finally, we need to know more about who makes the decision to go to which college and how this decision is made. It would appear that measurements of criteria are more troublesome than problems of prediction. We must increase our skills in measuring the output and link this output to both the student and the college environment if we are to continue to increase our understanding of the college experience. The problems are seen to be extremely complex when one considers that there are a multitude of student types attending different kinds of institutions for a large variety of reasons. The need for further study about educational choices seems especially important when one considers the declining numbers of college bound students and the current state of financial exigency faced by most colleges and universities.

The findings of this study generally indicate that intellective and non-intellective sets of measures are useful in predicting majors at time of graduation. The predictiveness is better for men-and-women-in-nonbusiness than it is for men-and-women-in-business. The predictions for women-in-business exceeded the classification accuracy for men-in-business. It appears, then, that men are less predictable than women.

The problem of being able to predict a major at the time of graduation using entrance data appears to be more of a criteria problem, i.e., what to measure, than a prediction problem. For example, the problem of predicting majors at graduation based on student interest in business is also a problem of predicting that student will finish their nonbusiness graduation requirements such as English, speech, physical education, general education and so forth. Thus, nonbusiness course completion might be studied as a predictive variable.

While it is generally well known that the decision to enter college is associated with occupational goal, socio-economic status, family aspirations, birth order, proximity of college, secondary school attended, educational achievement, ability and other variables. it is not well known how these variables are related to choice of educational major. (Dole and Digman, 1967). Future studies might be designed which incorporate these variables to see how the decision to go to college is linked to the decision to select a particular major while in college, and the completion of all graduation requirements.

Further studies might assess the extent that women possess the same characteristics of men but still do not elect to major in business. Understanding the reasons which keep potentially successful women out of business and understanding the reasons which keep marginally potential men in business majors, would enhance the quality of the counseling program in terms of matching men and women with majors for which they are more ideally suited.

Traditionally, it has been the men who have been taught from childhood to compete and achieve. Thus, it has been men who have developed enterprising personality types and interests in business contact. However it would appear

that some women have also developed these traits which are so closely connected to career fields in business management. Do these women end up in business majors and seek careers in businesses or with the government as professional managers? This would also make an informative study.

Sex appears to be a determining factor only to the extent that in our society women have different experiences throughout their formative years as compared to men. It is these experiences that shape a person's intellective and nonintellective characteristics. Since fewer women have the kinds of childhood experiences that men do, then it appears to follow that a smaller percentage of women as compared to men will major in business. Women have not traditionally had the opportunity to develop the aptitudes and interests which are necessary to influence their educational choices of selecting business majors. The reasons for this deserve further study.

Of interest to this researcher was the large number of women majoring in business who had competed in high school sporting competitions. It might be beneficial to study the influence of a wide variety of team and individual competition on the kinds of educational choices made by men and women. How does the "need to achieve" impact educational choices?

Those discriminant loadings not significant in the present study might be omitted from future studies; however, in making decisions about which variables to drop or which variables not to include in future studies, either a stepwise procedure or a factor analysis approach clearly seem to be superior approaches for researchers to follow. Researchers wishing to study the differences between individuals might wish to employ one of the various multivariate analysis techniques such as factor analysis prior to conducting a predictive study, or, to employ a stepwise multivariate procedure such as multiple analysis of variance. Further studies might add or subtract

various kinds of variables or sets of measures as they attempt to further answer the question of who makes which kinds of decisions when attending which types of institutions and how these decisions are made.

It would be interesting to be able to conduct a follow-up questionnaire to determine why the borderline men came to major in business. To what extent do societal or family pressures influence educational choice of majors for men versus women? The fact that borderline men tend to stay in business while borderline women do not, raises some interesting questions for further research. For example, some sort of "invisible hand" appears to be operating to keep borderline women out of business majors. This appears to open up the questions of differences between men and women in business; that is, the differences in the classification accuracies for the women-in-business and the men-in-business opens up the question of sex differences. Future studies will have to deal with this issue.

In closing it should be noted that high attrition rates have been costly to students and to institutions in terms of time, money, effort, and low student-completion rates. Based on the findings of this study the effectiveness and efficiency of the overall education program can and should be increased. And, any increase in effectiveness and efficiency during the 1980's will be most welcomed by those who benefit from higher education as well as by those who pay the bill(s).

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